JOURNAL
OF THE EAST AFRICA NATURAL HISTORY
SOCIETY AND NATIONAL MUSEUM

June 1993 Volume 82 (201)

A CHECK-LIST AND IDENTIFICATION KEY FOR SUCCULENT PLANTS IN GENERAL CULTIVATION IN NAIROBI

LEONARD E. NEWTON and PAUL K. MBUGUA
Department of Botany, Kenyatta University, P.O. Box 43844, Nairobi, Kenya

ABSTRACT

Following a survey of succulent plants in the gardens of 50 organisations and institutions in Nairobi, a check-list of over one hundred commonly cultivated species and varieties is presented. An identification key is provided, with characters described in non-technical language.

INTRODUCTION

In its situation on the eastern side of the Kenya highlands, Nairobi has a climate that includes long periods of drought, during which unwatered lawns turn brown and many herbaceous plants die if neglected. For this reason, succulent plants have long been regarded as eminently suitable for cultivation in public and private gardens in the city. Succulent plants have water reserves in special tissues, developed in either the stems or the leaves, and are adapted by evolution for surviving long periods of drought. Leaf succulents are valued as evergreen foliage plants. In most stem-succulents the leaves are reduced or absent, and the stems are green as they have taken over the functions of the leaves. As the stems enlarge to accommodate the stored water they often grow into bizarre shapes. In addition to the decorative value of their stems and leaves, many succulent plants produce abundant colourful flowers.

The succulent plants to be seen in cultivation in Nairobi include some indigenous species, which have been collected from the wild by residents. Most are exotic, the majority having been imported during early colonial days. The exotic species are mainly from the Republic of South Africa (R.S.A.), Madagascar, and the American continent. There are also some species from neighbouring countries in north-east Africa. With such diverse origins, there is no single guide to the identification of these plants. Indigenous species can be identified with the aid of the *Flora of Tropical East Africa* (Turrill *et al.*, 1952-), though accounts of some families that include succulent species, notably the Aloaceae, Asclepiadaceae and Compositae, have not yet been published.

Commonly cultivated exotic species are mentioned in the Flora, but are not included in the identification keys, and are not described. In order to identify exotic species, therefore, it is necessary to turn to monographs, if they exist for the families or genera concerned, and to foreign floras, if the country of origin is known. Another problem is that it is not easy to prepare herbarium specimens of succulent plants. Consequently, most species are not well represented in herbaria, and many of the specimens that do exist give a very poor idea of what the living plant is like. This makes it difficult to identify succulent plants by comparison with herbarium specimens. It should also be borne in mind that in cultivation spontaneous hybridisation can occur between plants that originate from different places, and the resulting hybrids can cause confusion in attempts at identification unless their hybrid nature is recognised.

METHODS

A survey of succulent plants in cultivation in Nairobi was carried out with the aim of determining the species grown, and preparing an identification key. Fifty sites were examined, including public gardens, private gardens, and gardens in the grounds of hotels and educational institutions. Samples of each species were collected for further study in cultivation at Kenyatta University. Voucher specimens have been deposited in the East African Herbarium (National Museums of Kenya, Nairobi) and their reference numbers are indicated after the names in the checklist. This survey concentrated on species in general cultivation. Specialist collections built up by gardeners interested in growing succulent plants as a hobby were excluded.

Numerous literature sources were used for identifying the plants, but in the following check-list most names are those given by Backeberg (1977) for members of the Cactaceae, and Jacobsen (1977) for succulents in other families. The choice of these two works as standards for names was based on the fact that they represent comprehensive surveys of succulent plants, and are generally available in libraries. Later names are used for some species in the check-list, but earlier and better-known names are also given where appropriate. It should be remembered that plant names are often subject to change as a result of taxonomic research, and even some fascicles of the *Flora of Tropical East Africa* are already out of date. Exotic species were found to be poorly represented in the East African Herbarium, and as the type specimens for these species are scattered around the world's herbaria final checking with type specimens to confirm the accuracy of the names was beyond the scope of this survey.

The check-list includes a number of 'borderline succulents', *i.e.* plants that are only slightly succulent, or are not strictly succulent but have enlarged organs that resemble those of succulent plants. Examples are *Chorisia speciosa* and *Plumeria acuminata*, which are trees with thick trunks and branches. Such species are included if they are featured in succulent plant literature. The geographical origin is given for each species, if known. The origin of some species is unknown because they were already in cultivation, with no record of their origin, when coming to the attention of taxonomists.

As far as possible, vegetative characters were used to construct the key, to facilitate identification of plants without flowers. Terminology is simplified as much as possible, to allow use of the key by readers without botanical training, and specialised technical terms have been used only where an alternative expression would be very lengthy.

CHECK-LIST

Agavaceae

Agave amaniensis Trel. & Nowell (origin unknown) (*Mbugua 147*)

Originally described from material found in cultivation in Tanzania. All members of this genus are from the American continent, but the exact origin of this species is unknown.

Agave americana L. cv. Marginata (Mexico) (*Mbugua 148*)

Agave angustifolia Haw. cv. Marginata (origin unknown) (*Mbugua 16*)

Agave attenuata Salm-Dyck (Mexico) (*Mbugua 81*)

Agave bourgaei Trel. (Mexico) (*Mbugua 88*)

Agave expansa Jacobi (Mexico) (*Mbugua 84*)

Agave sisalana Perr. (Mexico) (*Mbugua 73*)

Grown commercially for the fibres in the leaves, but occasionally seen in gardens.

Aizoaceae

Aptenia cordifolia (L. f.) Schwant. (R.S.A.) (*Mbugua 20*)

Carpobrotus edulis (L.) Bol. (R.S.A.) (*Mbugua 9*)
Lampranthus roseus (Willd.) Schwant. (R.S.A.) (*Mbugua 106*)

Aloaceae
Formerly included in the Liliaceae, but to be treated as a separate family in the *Flora of Tropical East Africa.*

Aloe bainesii Th. Dyer (R.S.A.) (*Mbugua 149*)
Aloe graminicola Reyn. (East Africa) (*Mbugua 85*)
Very close to *A. lateritia*, and possibly not a distinct species.
Aloe lateritia Engl. (East Africa) (*Mbugua 70*)
Aloe nyeriensis Christian (East Africa) (*Mbugua 150*)
Aloe secundiflora Engler (East Africa) -
Haworthia fasciata (Willd.) Haw. (*Mbugua 121*)

Apocynaceae
Adenium obesum (Forsk.) Roem. & Schult. (East Africa) (*Mbugua 79*)
Plumeria acuminata Ait. (Mexico) (*Mbugua 141*)

Asclepiadaceae
Caralluma dummeri (N.E.Br.) White & Sloane (East Africa) (*Mbugua 31*)
Stapelia leendertziae N.E.Br. (R.S.A.) (*Mbugua 54*)

Bombacaceae
Chorisia speciosa Saint Hil. (Brazil) (*Mbugua 144*)

Bromeliaceae
Dyckia sulfurea C. Koch. (Brazil) (*Mbugua 104*)

Cactaceae
Cereus peruvianus (L.) Mill. (South America) (*Mbugua 98*)
Cereus peruvianus (L.) Mill. f. *monstrosus* DC. (South America) (*Mbugua 56*)
Epiphyllum anguliger (Lem.) G. Don. (Mexico) (*Mbugua 92*)
Epiphyllum hybrid (*Mbugua 91*)
Heliocereus sp. (Guatemala/Mexico) (*Mbugua 135*)
Mammillaria elongata DC. var. *stella-aurata* (Mart.) K. Sch. (Mexico) (*Mbugua 117*)
Opuntia cylindrica DC. (Ecuador & Peru) (*Mbugua 43*)
Opuntia durangensis Br. & R. (Mexico) (*Mbugua 22*)
Opuntia microdasys (Lehm.) Pfeiff. (Mexico) (*Mbugua 113*)
Opuntia prasina Speg. (Argentina) (*Mbugua 97*)
Opuntia subulata Engelm. (Chile & Argentina) (*Mbugua 58*)
Opuntia vulgaris Mill. (Central America) (*Mbugua 39*)
Pachycereus orcuttii (K. Brand.) Br. & R. (USA) (*Mbugua 44*)
Schlumbergera bridgesii (Lem.) Loefgr. (Brazil) (*Mbugua 86*)
Formerly called *Zygocactus truncatus* (Haw.) K. Sch.
Probably of hybrid origin.

Commelinaceae
Tradescantia sillamontana Matuda (Mexico) (*Mbugua 82*)

Compositae
Senecio aizoides (DC.) Sch. Bip. (R.S.A.) (*Mbugua 11*)
Senecio crassissimus H. Humb. (Madagascar) (*Mbugua 61*)
Senecio hildebrandtii Bak. (Madagascar) (*Mbugua 64*)
Senecio jacobsenii Rowl. (East Africa) (*Mbugua 6*)
Senecio sempervivus (Forsk.) Sch. Bip. (East Africa) (*Mbugua 47*)

Crassulaceae
Aeonium arboreum (L.) Webb & Berth. cv. Atropurpureum (Mediterranean region) (*Mbugua 87*)
Aeonium haworthii (SD.) Webb. & Berth. (Canary Islands) (*Mbugua 52*)
Cotyledon coruscans Haw. (R.S.A.) (*Mbugua 50*)
Coytledon orbiculata L. (R.S.A.) (*Mbugua 59*)
Crassula argentea Thunb. (R.S.A.) (*Mbugua 65*)
Crassula multicava Lem. (R.S.A.) (*Mbugua 7*)
Crassula perfoliata L. (R.S.A.) (*Mbugua 15*)
Crassula portulacea Lam. (R.S.A.) (*Mbugua 49*)
Crassula sarmentosa Harv. (R.S.A.) (*Mbugua 17*)
Crassula schimperi Fisch. & Mey. (East Africa) (*Mbugua 14*)
Echeveria columbiana v. Poelln. (Columbia) (*Mbugua 28*)
Echeveria pulvinata Rose (Mexico) (*Mbugua 99*)
Echeveria tolimanensis Matuda (Mexico) (*Mbugua 142*)
Graptopetalum macdougallii Alexander (Mexico) (*Mbugua 138*)
Graptopetalum paraguayense (N.E.Br.) Walth. (Mexico) (*Mbugua 76*)
Graptopetalum pusillum Rose (Mexico) (*Mbugua 32*)
Kalanchoe beharensis Drake & Castello var. *aureo-aeneus* Jacobs. (Madagascar) (*Mbugua 80*)
Kalanchoe beharensis Drake & Castello var. *beharensis* (Madagascar) (*Mbugua 34*)
Kalanchoe delagoensis Eck. & Zeyh. (Madagascar) (*Mbugua 1*)
Formerly called *K. tubiflora* (Harv.) Hamet
Kalanchoe diagremontiana Hamet & Perr. (Madagascar) (*Mbugua 143*)
Kalanchoe fedtschenkoi Hamet & Perr. (Madagascar) (*Mbugua 3*)
Kalanchoe gastonis-bonnieri Hamet & Perr.(Madagascar) (*Mbugua 2*)
Kalanchoe hametorum Hamet (Mozambique) (*Mbugua 100*)
Kalanchoe longiflora Schltr. var. *coccinea* Marn.-Lap. (Tropical Africa) (*Mbugua 23*)
Kalanchoe longiflora Schltr. var. *longiflora* (Tropical Africa) (*Mbugua 5*)
Kalanchoe marmorata Bak. (East Africa) (*Mbugua 42*)
Kalanchoe marnieriana Jacobs. (Madagascar) (*Mbugua 89*)
Kalanchoe millotii Hamet & Perr. (Madgascar) (*Mbugua 90*)
Kalanchoe nyikae Engl. ssp. *nyikae* (East Africa)
As *Kalanchoe hemsleyana* Cuf. in Jacobsen.
Kalanchoe pinnata (Lam.) Persoon var. *calcicola* Perr. (Tropical Africa) (*Mbugua 145*)
Kalanchoe prolifera (Bowie) Hamet (Tropical Africa) (*Mbugua 26*)
Kalanchoe pumila Bak. (Madagascar) (*Mbugua 119*)
Kalanchoe rosei Hamet & Perr. (Madagascar) (*Mbugua 48*)
Kalanchoe scapigera Welw. (Angola) (*Mbugua 131*)
Kalanchoe thyrsiflora Harv. (R.S.A.) (*Mbugua 94*)
Sedum dendroideum Moc. & Sesse (Guatemala, Mexico) (*Mbugua 8*)
Sedum guatemalense Hemsl. (Guatemala) (*Mbugua 45*)
Sedum pachyphyllum Rose (Mexico) (*Mbugua 4*)
Sedum morganianum Walth. (Mexico) (*Mbugua 122*)
Sedum nussbaumeranum Bitter (Mexico) (*Mbugua 24*)

Sedum palmeri S. Wats. (Mexico) (*Mbugua 96*)

Dracaenaceae

Sansevieria caulescens N.E.Br. (East Africa) (*Mbugua 63*)
Sansevieria suffruticosa N.E.Br. (East Africa) (*Mbugua 103*)
Sansevieria robusta N.E.Br. (East Africa) (*Mbugua 30*)
Often referred to as *S. ehrenbergii*, but in Kenya that species occurs only in Coast Province.
Sansevieria trifasciata Prain cv. Hahnii (*Mbugua 102*)
Sansevieria trifasciata Prain var. *laurentii* (De Willd.) N.E.Br. (Congo Republic) (*Mbugua 72*)
Sansevieria trifasciata Prain var. *trifasciata* (Sri Lanka) (*Mbugua 12*)

Euphorbiaceae

Euphorbia arbuscula Balf. f. (Socotra) (*Mbugua 105*)
Euphorbia bussei Pax var. *kibwezensis* (N.E.Br.) Carter (East Africa) (*Mbugua 41*)
Formerly known as *E. kibwezensis* N.E.Br.
Euphorbia candelabrum Trem. (East Africa) (*Mbugua 101*)
Euphorbia milii Des Moulin (Madagascar)
A very variable species. Many varieties have been named, but hybrids between these have appeared in gardens and certain identification is difficult. The following varieties appear to be cultivated in Nairobi.
Euphoria milii Des Moulin var. *bevilaniensis* (Croiz.) Ursch & Leandri f. *rubro-striata* Drake & Castillo (*Mbugua 108*)
Euphorbia milii Des Moulin var. *hislopii* (N.E.Br.) Ursch & Leandri (*Mbugua 60*)
Euphorbia milii Des Moulin var. *imperatae* (Leandri) Ursch & Leandri (*Mbugua 109*)
Euphorbia milii Des Moulin var. *longifolia* Rauh (*Mbugua 107*)
Euphorbia milii Des Moulin var. *splendens* (Boj. ex Hook.) Ursch & Leandri (*Mbugua 21*)
Euphorbia milii Des Moulin var. *tulearensis* Ursch & Leandri (*Mbugua 112*)
Euphorbia obovalifolia A. Rich. (East Africa) (*Mbugua 133*)
Euphorbia stenoclada H. Baill. (Madagascar) (*Mbugua 95*)
Euphorbia tirucalli L. (East Africa) (*Mbugua 37*)
Euphorbia 'heterochroma' (East Africa)
Ten species are now recognised in this group, all formerly called *E. heterochroma* Pax or *E. stapfii* Berger. Specimens in cultivation collected in different areas represent different species. The one growing naturally in the southern Rift Valley of Kenya, near Nairobi, is *E. scarlatina* Carter.
Jatropha podagrica Hook. (Guatemala) (*Mbugua 78*)
Monadenium stapelioides Pax (East Africa) (*Mbugua 136*)
Pedilanthus tithymaloides Poit. (Central America) (*Mbugua 33*)
Synadenium grantii Hook. (East Africa) (*Mbugua 47*)

Labiatae

Coleus spicatus Benth. (India) (*Mbugua 36*)

Liliaceae

Bowiea volubilis Harv. & Hook. f. (East Africa to R.S.A.) (*Mbugua 124*)
East African plants formerly distinguished as *B. kilimandscharica* Mildbr.
Bulbine frutescens (L.) Willd. (R.S.A.) (*Mbugua 38*)

Portulacaceae

Portulaca cv. Grandiflora (origin unknown) (*Mbugua 10*)
Probably of inter-specific hybrid origin, but parent species unknown

Vitaceae
Cissus quadrangularis L. (East Africa) (*Mbugua 35*)

IDENTIFICATION KEY

Water storage in fat, fleshy stems, leaves less fleshy and commonly deciduous, reduced or absent: ..... stem succulents, Group I
Water storage in fat, fleshy ± persistent leaves, which are at least more succulent than the stems: ..... leaf succulents, Group II

GROUP I - Stem succulents

1 Stem angled, flat or grooved 2
Stem not angled, flat or grooved, ± cylindrical 22
2. Stem with milky latex 3
Stem without latex 7
3. Stem spiny or thorny 4
Stem neither spiny nor thorny ..... *Euphorbia arbuscula*
4. Stem 3-angled 5
Stem with more than 3 angles 6
5. Stems and leaves variegated ..... *Euphorbia obovalifolia*
Stem and leaves not variegated ..... *Euphorbia bussei* v. *kibwezensis*
6. Stem diameter over 7.0 cm, over 3.0 m high ..... *Euphorbia candelabrum*
Stem diameter about 1.5–2.0 cm, under 3 m high ..... *Euphorbia 'heterochroma'*
7. Stem flattened or jointed 8
Stem angular, grooved or tuberculate 14
8. Stem spiny or thorny 9
Stem neither spiny nor thorny 12
9. Spines weak, up to 1 cm long, or absent 10
Spines strong, over 2 cm long ..... *Opuntia vulgaris*
10. Spines present, accompanied by a few minute barbed bristles 11
Spines absent, stem with numerous minute yellow barbed bristles ..... *Opuntia microdasys*
11. Stem joints over 35 cm long, spines more than 1 cm long ..... *Opuntia prasina*
Stem joints less than 22 cm long, spines less than 1 cm long ..... *Opuntia durangensis*
12. Stem with hairs 13
Stem without hairs ..... *Epiphyllum* hybrid
13. Stem divided into short joints, 4–7 cm long ..... *Schlumbergera bridgesii*
Stem not divided into short joints ..... *Epiphyllum anguliger*
14. Stem spiny or thorny 15
Stem neither spiny nor thorny 19
15. Stem with more than 4 vertical grooves, no aerial roots 16
Stem with only 3 vertical grooves, and aerial roots ..... *Heliocereus* sp.
16. Young spines covered in woolly outgrowths ..... *Cereus peruvianus*
Young spines not covered in woolly outgrowths 17
17. Spines 1–4 together 18
Spines more than 4 together 21
18. Stem tips with needle-shaped succulent leaves, 2.5–4.0 cm long ..... *Opuntia subulata*
Stem tips with leaves 1–2 cm long, that soon fall ..... *Opuntia cylindrica*
19. Stem with tendrils, climbing ..... *Cissus quadrangularis*
Stem without tendrils, erect or creeping 20

20. Stem hairy, with teeth 0.2 cm long ..... *Stapelia leendertziae*
Stem not hairy, with conical teeth up to 1.4 cm long ..... *Caralluma dummeri*
21. Stem with parallel, vertical and continuous grooves, weak spines ..... *Pachycereus orcuttii*
Stem with discontinuous, zig-zag grooves, very firm spines .... *Cereus peruvianus* f. *monstrosus*
22. Stem thorny or spiny 23
Stem neither thorny nor spiny 32
23. Stem with milky latex 24
Stem without latex 31
24. Stem with numerous tubercles, and 2–3 small backward curved spines per tubercle ..... *Monadenium stapelioides*
Stem without tubercles 25
25. Inflorescence bright to dull red 26
Inflorescence bright to greenish-yellow 30
26. Stem 2 cm or more in diameter, leaf more than 10 cm long ..... *Euphorbia milii* v. *hislopii*
Stem less than 2 cm diameter, leaf less than 5 cm long 27
27. Floral bracts yellowish-red striate ..... *Euphorbia milii* v. *bevilaniensis* f. *rubro-striata*
Floral bracts entirely red or yellow 28
28. Leaves more than 3 times longer than wide ..... *Euphorbia milii* v. *longifolia*
Leaves less than 3 times longer than wide 29
29. Stems 5 mm diameter ..... *Euphorbia milii* v. *imperatae*
Stems at least 10 mm diameter 30
30. Thorns soft, 5–10 mm long ..... *Euphorbia milii* v. *tulearensis*
Thorns firm, more than 10 mm long ..... *Euphorbia milii* v. *splendens*
31. Tree with conical thorns on trunk; leaves palmate ..... *Chorisia speciosa*
Dwarf plant with clusters of needle-like spines on stem tubercles; leaves absent ..... *Mammillaria elongata* v. *stella-aurata*
32. Stem with milky latex 33
Stem without milky latex 36
33. Leaves variegated 34
Leaves (when present) not variegated 35
34. Stem with whitish-cream vertical bands ..... *Pedilanthus tithymaloides*
Stem without bands, pinkish to greenish bark ..... *Synadenium grantii*
35. Leaves persistent, to 20 cm long ..... *Plumeria acuminata*
Leaves short-lived, when present 1.0–1.5 cm long ..... *Euphorbia tirucalli*
36. Green shoots non-succulent, growing from bulb ..... *Bowiea volubilis*
Green shoots succulent and not distinct from storage organs 37
37. Leaves 20 cm or more long, lobed, stem surface rough ..... *Jatropha podagrica*
Leaves less than 2 cm long, simple spatula-shaped, stem surface smooth ..... *Adenium obesum*

GROUP II - Leaf succulents

1. Leaves simple 2
Leaves compound 75
2. Leaves thorny or spiny, sometimes with apical spine 3
Leaves neither thorny nor spiny (but may have a hardened tip, *e.g. Sansevieria* spp.) 14
3. Margin thorny or spiny 4
Margin neither thorny nor spiny, but apical spine present ..... *Agave sisalana*
4. Plant with obvious stem above ground 13
Plant without obvious stem above ground 5
5. Leaves tough, fibrous, not snapping cleanly when folded 6
Leaves scarcely fibrous, snapping cleanly when folded 9

6. Leaves with longitudinal coloured bands 7
   Leaves without coloured bands 11
7. Leaves with longitudinal ridges, slightly rough ..... *Agave amaniensis*
   Leaves without ridges, smooth 8
8. Leaves 2.4–2.6 m long ..... *Agave americana* cv. Marginata
   Leaves 0.5–0.6 m long ..... *Agave angustifolia* cv. Marginata
9. Leaves with white spots 10
   Leaves without spots ..... *Aloe secundiflora*
10. Lower leaf surface with white oblong spots except near tip ..... *Aloe lateritia*
    Lower leaf surface with white spots for whole length ..... *Aloe graminicola*
11. Leaves with numerous, small greenish-yellow vertical lines ..... *Dyckia sulfurea*
    Leaves without lines 12
12. Leaf surface rough, white-gray ..... *Agave expansa*
    Leaf surface smooth, grayish-green ..... *Agave bourgaei*
13. Stem covered with old leaves ..... *Aloe nyeriensis*
    Stem not covered with old leaves ..... *Aloe bainesii*
14. Leaves ± cylindrical, may be strap-shaped at base 15
    Leaves with at least 1 flat surface 27
15. Leaves produced in opposite pairs 16
    Leaves produced singly 18
16. Stem with hairs at nodes ..... *Portulaca* cv. Grandiflora
    Stem without hairs 17
17. Leaf with grayish-black spots ..... *Kalanchoe delagoensis*
    Leaf without spots ..... *Crassula schimperi*
18. Leaf tip rounded 19
    Leaf tip pointed 21
19. Stem hanging ..... *Sedum morganianum*
    Stem upright 20
20. Leaves with thick waxy bloom, greenish-white ..... *Sedum pachyphyllum*
    Leaves without waxy bloom, bright green ..... *Sedum guatemalense*
21. Leaves sheathed 22
    Leaves not sheathed 25
22. Leaves containing fibres 23
    Leaves not containing fibres ..... *Bulbine frutescens*
23. Leaf with groove near base ..... *Sansevieria robusta*
    Leaf with groove extending from base to over half-way up 24
24. Leaves 9–15 cm long ..... *Sansevieria suffruticosa*
    Leaves 60–90 cm long ..... *Sansevieria caulescens*
25. Stem with spines ..... *Opuntia subulata*
    Stem without spines 26
26. Leaves with thick waxy bloom ..... *Senecio aizoides*
    Leaves without waxy bloom ..... *Senecio hildebrandtii*
27. Leaves with 1–2 flat surfaces (underside may be rounded) 28
    Leaves with 3 flat surfaces (trigonous, especially at tips) 74
28. Leaf margin regular 29
    Leaf margin irregular 59
29. Leaf under surface ± rounded (esp. in young leaves) 30
    Leaf upper and under surfaces ± flat 37
30. Leaves hairy or scaly 31
    Leaves smooth, without hairs or other ornamentation 32

31. Leaves hairy, giving grayish colour ..... *Echeveria pulvinata*
Leaves not hairy ..... *Haworthia fasciata*
32. Upper leaf surface ± concave (esp. at base) 33
Upper leaf surface completely flat 36
33. Leaf with keel, edge sharp 34
Leaf without keel, edge rounded ..... *Cotyledon coruscans*
34. Leaf 8–15 cm long 35
Leaf 5.0–6.5 cm long ..... *Graptopetalum pusillum*
35. Leaf tip extended into a bristle ..... *Echeveria tolimanensis*
Leaf tip not extended into a bristle ..... *Graptopetalum paraguayense*
36. Leaves with thick waxy bloom ..... *Echeveria columbiana*
Leaves without waxy bloom ..... *Sedum nussbaumeranum*
37. Leaves with fibres 38
Leaves without fibres 41
38. Leaves with gray-green transverse bands 39
Leaves without bands ..... *Agave attenuata*
39. Leaves with yellowish-white stripes along the margins ..... *Sansevieria trifasciata* v. *laurentii*
Leaves without stripes 40
40. Leaves with parallel sides, to 90 cm long ..... *Sansevieria trifasciata* v. *trifasciata*
Leaves with rounded sides, to 10 cm long ..... *Sansevieria trifasciata* cv. Hahnii
41. Stem lying on ground 42
Stem upright 44
42. Plant hairy ..... *Tradescantia sillamontana*
Plant not hairy 43
43. Leaves produced in opposite pairs, tips pointed ..... *Aptenia cordifolia*
Leaves produced singly, tips rounded ..... *Senecio jacobsenii*
44. Plant with milky latex 45
Plant without latex 46
45. Leaves variegated gray-green ..... *Pedilanthus tithymaloides*
Leaves not variegated ..... *Monadenium stapelioides*
46. Leaves produced in opposite pairs 47
Leaves produced singly 55
47. Leaf tips rounded 48
Leaf tips pointed (at least in young stage) 50
48. Leaf surface marked with minute spots 49
Leaf surface without minute spots 52
49. Leaves with pinkish-green tips ..... *Crassula portulacea*
Leaves dark green throughout ..... *Crassula multicava*
50. Leaf base extended as two rounded lobes
below attachment to stalk ..... *Kalanchoe marnieriana*
Leaf base entirely above attachment to stalk 51
51. Leaves clasping the stem, 10–15 cm long, 7–9 cm wide ..... *Kalanchoe thyrsiflora*
Leaves not clasping the stem, 7–9 cm long, 4–6 cm wide ..... *Cotyledon orbiculata*
52. Leaves with velvety hairs ..... *Kalanchoe scapigera*
Leaves not hairy 53
53. Leaves with stalks 54
Leaves without stalks ..... *Crassula perfoliata*
54. Plant with thick waxy bloom ..... *Kalanchoe hametorum*
Plant without waxy bloom ..... *Crassula argentea*

55. Leaves without stalks 56
Leaves with stalks 57
56. Leaf tip pointed ..... *Graptopetalum macdougallii*
Leave tip rounded ..... *Sedum palmeri*
57. Leaf surface horny ..... *Senecio crassissimus*
Leaf surface not horny 58
58. Leaf veins visible on both surfaces ..... *Senecio sempervivus*
Leaf veins not visible on upper surface,
only major vein visible on underside ..... *Sedum dendroideum*
59. Stem with 4 angles 60
Stem ± cylindrical 61
60. Plant hairy ..... *Coleus spicatus*
Plant not hairy ..... *Kalanchoe longiflora* v. *longiflora*
61. Leaves stalked 62
Leaves not stalked 71
62. Leaves smooth 63
Leaves with fine hairs 70
63. Leave base extended as two rounded lobes below attachment to stalk 64
Leaf base entirely above attachment to stalk 65
64. Leaves ovate ..... *Kalanchoe fedtschenkoi*
Leaves lanceolate ..... *Kalanchoe rosei*
65. Leaf stalk attached to lower surface of blade 66
Leaf stalk attached to edge of blade 67
66. Leaf margins wavy ..... *Kalanchoe beharensis* v. *beharensis*
Leaf margins toothed ..... *Kalanchoe diagremontiana*
67. Leaves with thick waxy bloom 68
Leaves without waxy bloom 69
68. Leaf margin teeth with bluish-pink base (especially on old leaves) ..... *Kalanchoe hemsleyana*
Leaf margin teeth same colour as blade at the base ..... *Kalanchoe pumila*
69. Leaf surface marked with minute spots ..... *Crassula sarmentosa*
Leaf surface without minute spots ..... *Kalanchoe longiflora* v. *coccinea*
70. Leaves and stem (esp. young stems) velvety ..... *Kalanchoe beharensis* v. *aureo-aeneus*
Leaves and stems with tufts of soft hairs ..... *Kalanchoe millotii*
71. Leaves produced in opposite pairs 72
Leaves produced singly 73
72. Leaf tip with pointed elongation ..... *Kalanchoe gastonis-bonnieri*
Leaf tip rounded ..... *Kalanchoe marmorata*
73. Leaves light gray-green ..... *Aeonium haworthii*
Leaves dark-brownish purple ..... *Aeonium arboreum* cv. Atropurpureum
74. Leaves 2–4 cm long ..... *Lampranthus roseus*
Leaves 8–10 cm long ..... *Carpobrotus edulis*
75. Stem 4-angled (esp. in youngest parts), diameter 4–6 cm ..... *Kalanchoe prolifera*
Stem ± cylindrical, diameter 2–3 cm. ..... *Kalanchoe pinnata* v. *calcicola*